tions to important physical problems, including wave propagation, Maxwell's equations, theory of electrons, Laplace's equation and harmonic equations.

The last chapter describes various mechanical contrivances for solving certain differential equations of special forms. Several of these are due to E. Pascal, who has devised a number of instruments for this purpose.

Throughout the book there are many typographical errors. Most of them are easily corrected by the reader, but at least one of them has caused trouble to an unwary instructor.

The reviewer feels that the book will be difficult reading for a student beginning the study of differential equations, but that can be determined only by trying it out with a class. The book will surely prove to be a valuable addition to the library of the worker in mathematical physics.

CHARLES L. BOUTON.

HARVARD UNIVERSITY,
    June, 1920.

The Theory of Determinants in the Historical Order of Development. By THOMAS MUIR. Volume 3, the period 1861 to 1880. London, Macmillan, 1920. 8vo. 26 + 503 pp. Price 35 shillings.

The first edition of the first volume of this work was reprinted in book form, in 1890, from the *Proceedings of the Royal Society of Edinburgh;* a second edition, with over 200 pages of additional material, appeared in 1906, and covered the history of general and special determinants up to 1841. The second volume (1911) made a similar survey for the period 1841 to 1860. The third volume under review covers an additional twenty year period. In June, 1918, the manuscript of a fourth volume bringing the record up to the end of the nineteenth century was nearly complete. Mathematicians must ever be grateful to Sir Thomas for his monumental work which is designed to contain a complete record of published results in connection with the theory of determinants.

The material is admirably arranged and indexed so that it is possible readily to trace the contributions to the theory of any individual, or the chronological development of any special type of determinants. For example chapter 14 in volume 2 and chapter 15 in volume 3 contain the history of circulants from the first paper of Catalan in 1846 to the last of Gegenbaur in 1880; skew determinants may be traced in a similar way in the fourteenth, ninth and tenth chapters of volumes 1, 2 and 3 respectively. Although a three page chapter is devoted to "cubic and n-dimensional determinants up to 1880" and various titles are listed, practically as in the article of 1900 by Professors Hedrick and Cairns,[1] the contents of the papers are not analyzed as in the other chapters because the work in question is a survey of determinants as ordinarily defined, and not of their generalizations.

The titles of the chapters are as follows—I: "Determinants in general, from 1860 to 1880," 1–82; II: "Determinants and linear equations, from 1861 to 1878," 83–93; III: "Axisymmetric

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[1] "On three dimensional determinants," *Annals of Mathematics,* second series, vol. 1, pp. 49–67.

determinants, from 1846 to 1879," 94–122; IV: "Symmetric determinants that are not axisymmetric, from 1862 to 1879," 123–131; V: "Alternants from 1860 to 1879," 132–175; VI: "Compound determinants from 1862 to 1880," 176–207; VII: "Recurrents from 1858 to 1879," 208–247; VIII: "Wronskians from 1862 to 1874," 248–256; IX: "Jacobians from 1862 to 1877," 257–271; X: "Skew determinants and Pfaffians from 1862 to 1880," 272–283; XI: "Orthogonants from 1855 to 1879, 284–308; XII: "Persymmetric determinants from 1836 to 1879," 309–326; XIII: "Bigradients from 1859 to 1880," 327–362; XIV: "Hessians, from 1862 to 1879," 363–371; XV: "Circulants, from 1861 to 1880," 372–392; XVI: "Continuants from 1850 to 1880," 393–422; XVII: "Multilineants up to 1877," 423–428; XVIII: "Cubic and n-dimensional determinants up to 1880," 429–431; XIX: "Bordered determinants up to 1880," 432–446; XX: "Determinants whose elements are combinatory numbers up to 1880," 447–462; XXI: "Zero-axial determinants up to 1888," 463–468; XXII: "The less common special forms from 1839 to 1880," 469–496; "List of authors," 497–503.

<div align="right">R. C. ARCHIBALD.</div>

College Teaching. Studies in Methods of Teaching in the College. Edited by PAUL KLAPPER with an Introduction by N. M. Butler. Yonkers-on-Hudson, New York, World Book Co., 1920. 16 + 583 pp.

This book contains twenty-eight chapters by as many different authors. Chapter VIII (pages 161–182) on "The Teaching of Mathematics" is by G. A. MILLER. The sub-headings of the chapter are as follows: Recent changes and some of their sources; Influence of researches in mathematics on methods of teaching; Range of subjects and preparation of students; Variety of college courses in mathematics; History of college mathematics; Relation of mathematics in secondary school and college; Aims of college mathematics: methods of teaching; Advanced work in college mathematics; Mathematics and technical education; Preparation of the college teacher of mathematics; The mathematical text-book.

The Teaching of Arithmetic. By JOHN C. STONE. Chicago, Benj. H. Sanborn & Company, 1918. 262 pp. Price $1.32.

This presents for teachers, supervisors, and those preparing to teach, "a discussion of the aims and purposes of a course in arithmetic and of the methods of presenting each topic that should find a place in our elementary schools." The final chapter, on "Measuring results," gives an account of the standard arithmetic tests developed during the last twenty years.

<div align="center">NOTES.</div>

In T. ZIEHEN, *Lehrbuch der Logik auf positivistischer Grundlage mit Berücksichtigung der Geschichte der Logik,* (Bonn, A. Marucs & E. Webers Verlag, 1920), are discussed: "Die mathematische (symbolistische) Logik" pp. 227–236 including a bibliography of about 35 authors; "Mathematische Grundlegung der Logik," pp. 410–416.

A new list of the members of the Mathematical Association (England) was published in April, 1920. It contains the names of 9 "honorary members," of 747 "ordinary members", and of 83 "associates" of the London, Yorkshire, North Wales, and Sydney (New South Wales) Branches.